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## PATENT ABSTRACTS OF JAPAN

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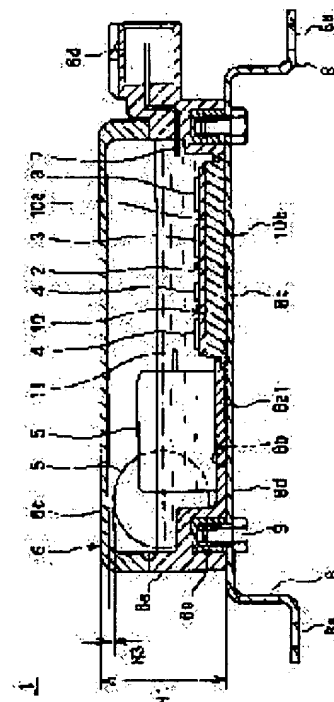
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## (54) ELECTRONIC DEVICE

## (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide an electronic device 1 which can be reduced in weight while maintaining the heat radiation by improving a heat radiation structure for the heat generated by power semiconductor elements 3 or the like in a case 6.

**SOLUTION:** In the case 6, a heat sink 10 (heat transmission member) formed into nearly the same flat shape as circuit board 2 is integrally formed by resin insert molding. The circuit board 2 is fixed to a first surface 10a of the heat sink 10 which faces the inside of the case 6 so that it is nearly completely overlaid on the first surface 10a. A second surface 10b of the heat sink 10 on the opposite side from the first surface 10a exposed outside the case 6, and the whole of the second surface is airtightly disposed on the surface 8b of a bracket 8 so that the heat can be transmitted to the surface 8b of the bracket 8. Due to this structure, a conventional bottom plate 6b can be replaced with the small-size heat sink 10 while maintaining the heat radiation for the heat generated by the power semiconductor elements 3, and reducing the weight of the electronic device 1.



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**CLAIMS**

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[Claim(s)]

[Claim 1] While being arranged in a different location from the circuit board which mounted two or more electronic parts containing a power semiconductor device, and said circuit board In an electronic instrument equipped with the case made of resin where the electrical part which is electrically connected with said circuit board and constitutes an electrical circuit, and said circuit board and said electrical part are held, and the metal bracket for anchoring attached in said case In the 1st front face which said circuit board and the heat transfer member formed in the abbreviation same flat-surface configuration are fixed in said case, and faces in the case of said heat transfer member said circuit board -- \*\*\*\* -- the electronic instrument characterized by enabling adhesion arrangement of the heat transfer to said bracket while being fixed like and exposing the 2nd front face of the opposite side of the 1st front face out of said case.

[Claim 2] Said bracket is an electronic instrument according to claim 1 characterized by having the applied part which can be stuck to said 2nd whole front face of said heat transfer member.

[Claim 3] Said bracket is an electronic instrument given in any of claim 1 characterized by being formed by one member which has two or more holes for attaching said case in an external anchoring member, or claim 2 they are.

[Claim 4] An electronic instrument given in any of claim 1 characterized by forming two or more heights in either [ at least ] said 2nd front face of said heat transfer member which counters, or the front face of said bracket thru/or claim 3 they are.

[Claim 5] Said heat transfer member is an electronic instrument given in any of claim 1 characterized by really being fabricated by said case with insertion resin shaping thru/or claim 4 while being formed with a metal, they are.

[Claim 6] An electronic instrument given in any of claim 1 characterized by preparing a radiation fin in the field attached in said case, and the front face of said bracket of the opposite side thru/or claim 5 they are.

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## DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the electronic instrument which comes in a case to hold the circuit board and the electrical part which mounted two or more electronic parts containing power semiconductor devices, such as a power transistor.

[0002]

[Description of the Prior Art] As a conventional electronic instrument, there is an electronic instrument for engine control of a car. Since this electronic instrument 100 has the power semiconductor devices 3, such as a power transistor, the circuit board 2 in which two or more electronic parts 4 were mounted, and large components size as shown in drawing 4, it is arranged on the outside of the circuit board 2, holds two or more electrical parts 5 (for example, a capacitor, a coil, etc.) which are connected electrically and constitute one electrical circuit on the whole in a case 6, and is constituted. Furthermore, this case 6 is attached in the car or the engine through the bracket 8.

[0003] The power semiconductor devices 3, such as a power transistor mounted on the circuit board 2, generate heat during actuation. In order to operate this power semiconductor device 3 normally, it is necessary to radiate heat outside in that heat to generate, and to maintain the temperature of the power semiconductor device 3 below to a predetermined value.

[0004] In the conventional electronic instrument 100, bottom plate 6b which becomes one side of the frame 6f open end fabricated in the shape of \*\*\*\* with the resin ingredient from an aluminum plate is fixed by adhesion etc., and the case 6 is formed. And adhesion immobilization of the circuit board 2 is carried out with the adhesives of high temperature conductivity on the front face inside the case 6 of bottom plate 6b. Thereby, the heat which the power semiconductor device 3 on the circuit board 2 generates is conducted from the circuit board 2 to bottom plate 6b, and radiates heat in the open air by the free convection from the outside surface six b1 of bottom plate 6b further. Since the various electrical parts 5 are also arranged in a case 6, the area of bottom plate 6b is larger than the area of the circuit board 2. Moreover, that the temperature of the power semiconductor device 3 should be maintained below to a predetermined value, the thickness of bottom plate 6b is thickly formed, in order to obtain sufficient heat capacity on heat dissipation of the circuit board 2.

[0005]

[Problem(s) to be Solved by the Invention] In recent years, there is a strong demand of lightweight-izing and a miniaturization also to an electronic instrument for the improvement in fuel consumption and the improvement in attachment workability of a car.

[0006] In the conventional electronic instrument 100, as mentioned above, while forming the whole bottom plate 6b with aluminum, thickness of bottom plate 6b is thickened for heat dissipation engine-performance reservation. Therefore, there was a problem that the weight of an electronic instrument 100 will become large.

[0007] while this invention is made in view of the above point, the purpose improves the heat dissipation structure of the heat which the power semiconductor device held in the case generates and the heat dissipation engine performance is secured -- lightweight -- it is in offering the electronic instrument [-izing / an electronic instrument ].

[0008]

[Means for Solving the Problem] This invention adopts the following technical means in order to attain the above-mentioned purpose.

[0009] the 1st front face which the circuit board and the heat transfer member formed in the abbreviation same flat-surface configuration are fixed in a case in the electronic instrument of this invention according to claim 1, and faces in the case of this heat transfer member -- the circuit board -- \*\*\*\* -- while being fixed like, the 2nd front face of the

opposite side of the 1st front face was considered as the configuration adhesion arrangement of the heat transfer of to a bracket is enabled while being exposed out of the case. Other case parts can attain lightweight-ization of the whole part case by excluding a heat transfer member by this preparing a heat transfer member in the part of the circuit board in which the power semiconductor device was mounted within the case. And by carrying out adhesion arrangement of the heat transfer member and mounting bracket, the fall of the heat capacity of a heat transfer member is compensated, and the heat dissipation engine performance can be secured.

[0010] In the electronic instrument of this invention according to claim 2, the bracket was considered as the configuration which has the applied part which can be stuck to the 2nd whole front face of a heat transfer member. By this, sufficient transfer heating value from a heat transfer member to a bracket is secured, the fall of the heat capacity of a heat transfer member is compensated, and the heat dissipation engine performance can be secured.

[0011] In the electronic instrument of this invention according to claim 3, the bracket was considered as the configuration currently formed by one member which has two or more holes for attaching a case in an external anchoring member. Thereby, heat can be certainly radiated from a heat transfer member to an external anchoring member through a bracket.

[0012] Two or more heights were formed in at least the 2nd front face of the heat transfer member which counters, or the front face of a bracket either in the electronic instrument of this invention according to claim 4. Thereby, if a bracket is attached in a case, a heat transfer member and a bracket can carry out press contact certainly, and can radiate heat from a heat transfer member certainly to a bracket.

[0013] In the electronic instrument of this invention according to claim 5, the heat transfer member was considered as the configuration really fabricated by the case with insertion resin shaping while it was formed with the metal. Thereby, the man-hour for assembly at the time of the assembly of an electronic instrument can be reduced.

[0014] In the electronic instrument of this invention according to claim 6, the radiation fin was prepared in the field attached in a case, and the front face of the bracket of the opposite side. Thereby, heat can be certainly radiated to air in the heat transmitted from the heat transfer member to the bracket.

[0015]

[Embodiment of the Invention] Hereafter, the case where this invention is applied to the electronic instrument for control of the engine for cars is explained to an example based on a drawing. In addition, in each drawing, the same sign is given to the same component.

[0016] The sectional view of the electronic instrument 1 by 1 operation gestalt of this invention is shown in drawing 1.

[0017] the circuit board 2 to which the electronic instrument 1 mounted the power semiconductor device 3 and two or more electronic parts 4 in the interior of a case 6 -- and The electrical part 5 which is arranged on the outside of the circuit board 2 since components size is large, is electrically connected to the circuit board 2, and constitutes one electrical circuit on the whole (For example, a capacitor, a coil, etc. are contained), it is constituted, and further, a bracket 8 binds a bolt 9 tight in a case 6, it is fixed to it, this bracket 8 is minded, and the electronic instrument 1 is being fixed to the predetermined part or predetermined engine on a car. Moreover, an electronic instrument 1 is electrically connected to a case 6 with the exterior through connector 6d prepared in one.

[0018] Hereafter, the configuration of an electronic instrument 1 is explained to a detail.

[0019] The circuit board 2 consists of a ceramic substrate, and the power semiconductor devices 3 (for example, bare chip mold power transistor etc.) and two or more electronic parts 4 (for example, resistance of a bare chip mold, a capacitor, IC component, etc.) are mounted. Since the power semiconductor device 3 generates heat during actuation of an electronic instrument 1, in order to maintain the normal function of the power semiconductor device 3, it is necessary to radiate heat outside in the heat to generate, and to maintain the temperature of the power semiconductor device 3 below to a predetermined value here. For this reason, the circuit board 2 is being fixed in the case 6 by the heat sink 10 mentioned later.

[0020] The case 6 consists of body section 6a which carries out hold immobilization of the circuit board 2 and the electrical part 5, and covering 6c which maintains the airtight in body section 6a and which is a lid greatly. Body section 6a and covering 6c fabricate a resin ingredient, and are made.

[0021] The circuit board 2 is attached in the pars basilaris ossis occipitalis of body section 6a, and the heat sink 10 which is a heat transfer member for transmitting the heat which the power semiconductor device 3 mounted on the circuit board 2 generates to the exterior 8 of a case 6, i.e., the bracket mentioned later, is formed in it in one with body section 6a by insertion resin shaping.

[0022] This heat sink 10 is formed from the quality of the material which is excellent in thermal conductivity, for example, aluminum, and that magnitude (flat-surface configuration) is formed almost similarly to the circuit board 2. That is, it is smaller than bottom plate 6b in the conventional electronic instrument 100. On 1st flat-surface 10a which is

the flat surface which faces in the case 6 of a heat sink 10, adhesion immobilization of the circuit board 2 is carried out by high temperature conductivity adhesives. Thereby, the heat which the power semiconductor device 3 generates can be efficiently transmitted to a heat sink 10 from the circuit board 2. On the other hand, 2nd flat-surface 10b which is the flat surface of the opposite side of 1st flat-surface 10a of a heat sink 10 is projected outside the outside surface six a1 of body section 6a while exposing from a case 6. Therefore, by \*\*\*\*ing a bracket 8 to body section 6a, binding 9 tight and fixing, press contact of the whole surface of 2nd flat-surface 10b and the applied part 8e in a bracket 8 can be carried out certainly, and heat conduction between a heat sink 10 and applied part 8e continues all over flat-surface 10of \*\* 2nd b, and is performed certainly. That is, the heat which the power semiconductor device 3 generates can be further transmitted to a heat sink 10 certainly from a heat sink 10 from the circuit board 2 to a bracket 8, and heat can be further radiated during the open air from the front face of a bracket 8.

[0023] Moreover, in this example, as shown in drawing 1, the upper limit of an electrical part 5 is located more nearly up than the upper limit of the upper limit 3 of the circuit board 2, i.e., a power semiconductor device, and electronic parts 4. Therefore, if the clearance dimension H3 of an electrical part 5 and covering 6c is set up equally to the clearance dimension H3 in the conventional electronic instrument 100, the thickness dimension H1 (H1 in drawing 1) of an electronic instrument 1 will be made by having considered body section 6a as the above configurations smaller than the thickness dimension H2 (H2 in drawing 2) of the conventional electronic instrument 100. That is, an electronic instrument 1 can be miniaturized.

[0024] Moreover, insert molding of the screw thread 9 for fixing a bracket 8 and the sleeve 6e to screw is carried out to body section 6a. Furthermore, connector 6d for connecting an electronic instrument 1 with the exterior electrically is really formed by shaping.

[0025] The bracket 8 for fixing an electronic instrument 1 to a car or an engine carries out press forming of a metal, for example, the steel plate, and is made, and it has fixed hole 8a for fixing a bracket 8 to metal frames, such as a car body which is an external anchoring member, or an engine, by thread fastening. Applied part 8c which is a part corresponding to the heat sink 10 in surface 8b which is the near field in which the case 6 of a bracket 8 is attached is set as the configuration which can radiate heat during the open air in the heat which the power semiconductor device 3 generates so that the whole surface of 2nd flat-surface 10b of a heat sink 10 may contact and the temperature of the power semiconductor device 3 can be maintained proper. Furthermore, it constitutes from one member which has two or more fixed hole 8a (usually two or more places) as a configuration of a bracket 8, and he makes the heat received from all the rear faces of the circuit board 2 into the structure which can be promptly heat-transferred to all the fixed hole 8a side, and is trying to make heat radiate to an external anchoring member side, such as a car body. In other words, a bracket 8 is made to have a function as a heat dissipation means of the heat which the power semiconductor device 3 generates. Therefore, bottom plate 6b in the conventional electronic instrument 100 becomes unnecessary, and can lightweight-ize an electronic instrument 1.

[0026] Next, how the electronic instrument 1 in 1 operation gestalt of this invention should grapple is explained briefly.

[0027] By this time, mounting of the power semiconductor device 3 and two or more electronic parts 3 is completed to the circuit board 2.

[0028] First, an electrical part 5 is attached in the position of body section 6a of a case 6, then adhesion immobilization of the circuit board 2 is carried out with high temperature conductivity adhesives at the 1st flat surface of a heat sink 10.

[0029] Next, the circuit board 2, an electrical part, and a terminal 7 are electrically connected by wirebonding, fusing, etc., and the electrical circuit as an electronic instrument 1 is formed.

[0030] Next, silicon gel (not shown) is poured into the interior of body section 6a. Silicon gel is poured in so that the electrical connection by above-mentioned wirebonding, fusing, etc. may be completely buried into it, and thereby, the opposite \*\*\*\* of an electrical connection and a water resisting property are maintained.

[0031] Next, covering 6c is fixed to body section 6a by adhesion. The airtight inside a case 6 is maintained by covering 6c.

[0032] A bracket 8 is bound tight, at the end, a bolt 9 is bound tight in a case 6, and it fixes. Thereby, the 2nd flat surface and bracket of a heat sink 10 carry out press contact, and heat transfer between both becomes certainly possible.

[0033] In the electronic instrument 1 by 1 operation gestalt of this invention explained above In a case 6, the heat sink 10 (heat transfer member) formed in the circuit board 2 and an abbreviation same flat-surface configuration is really fabricated by insertion resin shaping. In the 1st surface 10a which faces in the case 6 of this heat sink 10 the circuit board 2 -- \*\*\*\* -- while being fixed like, the whole surface considered 2nd surface 10b of the opposite side of 1st surface 10a as the configuration adhesion arrangement of the heat transfer of to surface 8b of a bracket 8 is enabled while being exposed out of the case 6. While transmitting the heat which the power semiconductor device 3 mounted on the circuit board 2 generates by this to a bracket 8 through a heat sink 10 and radiating heat in the open air from the

front face of a bracket 8, he is trying to make heat radiate to an external anchoring member side, such as a car body or an engine, through fixed hole 8a. That is, by making the heat dissipation function by bottom plate 6b of the conventional electronic instrument 100 achieve, the conventional bottom plate 6b can be abolished to a bracket 8, and an electronic instrument 1 can be lightweight-ized to it.

[0034] Moreover, the man-hour for assembly at the time of an assembly can be reduced by really fabricating a heat sink 10 with insertion resin shaping in a case 6.

[0035] Next, the 1st modification of the electronic instrument 1 by 1 operation gestalt of this invention is explained.

[0036] The fragmentary sectional view of the 1st modification of the electronic instrument 1 by 1 operation gestalt of this invention is shown in drawing 2.

[0037] In this 1st modification, while forming two or more heights 10c in 2nd flat-surface 10b of a heat sink 10 by press working of sheet metal etc. to the electronic instrument 1 by 1 above-mentioned operation gestalt, two or more heights 8e was formed in flat-surface 10b and the part which counters of surface 8b of a bracket 8 by press working of sheet metal etc. at least. Furthermore, since the pitch dimension P1 of heights 10c was set up equally to the pitch dimension P2 of heights 8e, if a bracket 8 is attached in a case 6, it will contact so that it may gear mutually, as it is indicated in drawing 2 as two or more heights 10c and two or more heights 8e. By this, the touch area of a heat sink 10 and a bracket 8 can be increased, the amount of heat transfers from a heat sink 10 to a bracket 8 can be secured enough, and heat can be certainly radiated in the open air from the front face of a bracket 8 in the heat which the power semiconductor device 3 generates.

[0038] In addition, in this 1st modification, either two or more heights 10c or two or more heights 8e may be omitted.

[0039] Next, the 2nd modification of the electronic instrument 1 by 1 operation gestalt of this invention is explained.

[0040] The fragmentary sectional view of the 2nd modification of the electronic instrument 1 by 1 operation gestalt of this invention is shown in drawing 3.

[0041] In this 2nd modification, to the electronic instrument 1 by 1 above-mentioned operation gestalt, at least, as shown in drawing 3, 8f of two or more radiation fins was formed in flat-surface 10b and the part which counters of 8d of rear faces on the background of surface 8b of a bracket 8. Heat can be certainly radiated in the open air from the front face of a bracket 8 in the heat which is made to increase the heat release from a bracket 8 to under the open air, and the power semiconductor device 3 generates by this.

[0042] In addition, it sets in the electronic instrument 1 by 1 operation gestalt of this invention explained above, the 1st modification, and the 2nd modification. In order to fill the minute clearance between 2nd flat-surface 10b of a heat sink 10, and a bracket 8 and to raise the heat transfer engine performance between both Silicon gel may be applied between 2nd flat-surface 10b of a heat sink 10, and a bracket 8, or the heat dissipation sheet which is excellent in thermal conductivity and consists of flexible polymeric materials may be made to intervene.

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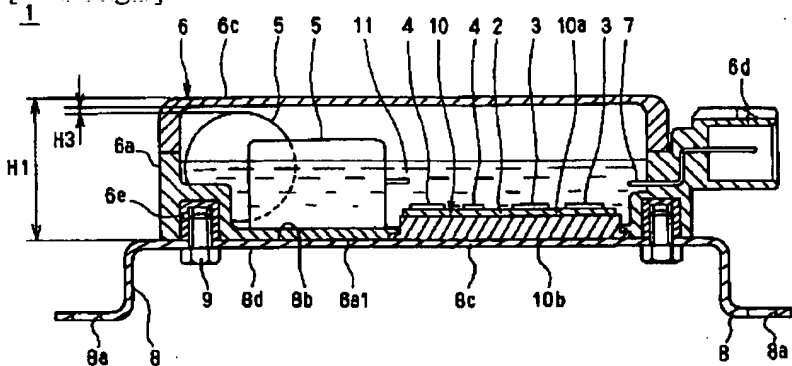
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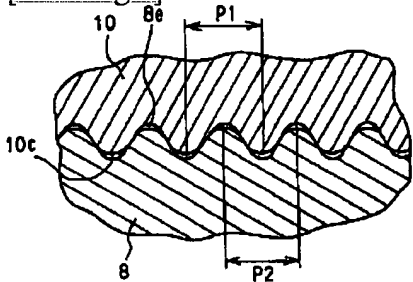
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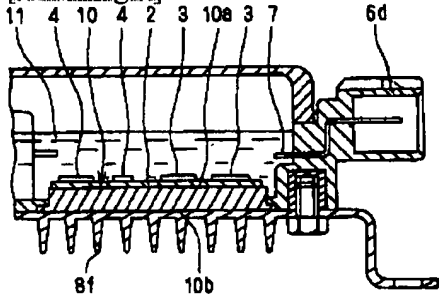
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[Drawing 2]



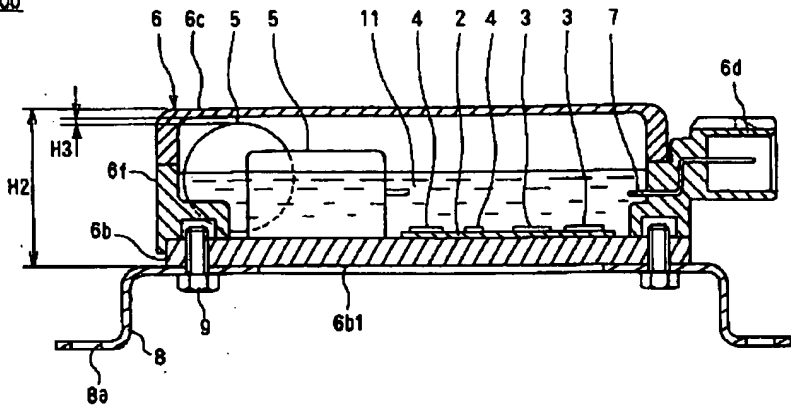
[Drawing 3]



[Drawing 4]



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